CHAPTER 4 -- SAFETY

OBJECTIVES

After studying the contents of this chapter and reviewing them with your instructor, you will be able to:

1. Describe the hazards associated with the operation and testing of loading-rack metering systems.

2. Identify items of safety equipment and their use.

3. Describe basic safety procedures that must be observed during field examinations of loading-rack metering systems.

4. Describe the responsibilities of the weights and measures official in the event of an emergency.

INTRODUCTION

Safety has an important place in the training of anyone who works with loading-rack metering systems. This chapter is thus intended to provide an orientation to a topic that your instructors, supervisors, and colleagues in weights and measures will discuss, review, and reinforce repeatedly.

Modern loading-rack metering systems are designed, constructed, and installed according to strict codes and regulations that are intended to insure safe operation, and are generally enforced, not only by public officials, but by insurance companies and device owners. The same is true of the equipment used to test these devices. In addition, the personnel who operate loading-rack metering systems are thoroughly trained, like you, to perform their tasks safely and how to react in an emergency.

As a result, the likelihood of an accident occurring during the examination of a loading-rack metering system is not inherently greater than the risk of an accident occurring during the examination of most other types of weighing and measuring devices.

At the same time, you must be aware that the petroleum products are fuels, and thus highly flammable. Many are also volatile, and produce toxic and/or potentially explosive vapors. There is no reason, of course, why you should ever be exposed to dangerous levels of either liquid product or vapors. Nothing in your inspection or test procedures involves actual handling of the product, and if you observe proper safety precautions the risk of an accident occurring will be minimal.

However, as you have learned, loading-rack metering systems deliver product at very high discharge rates, and in the unlikely event of an accident while the system is operating, the extent of exposure could be large. You must therefore know how to anticipate situations that could become dangerous and be prepared to respond if something should go wrong.

The most important safety equipment you will carry into the field with you will be your knowledge. You must:

> KNOW THE PHYSICAL AND CHEMICAL PROPERTIES OF THE SUBSTANCES YOU ARE DEALING WITH.
>
> KNOW HOW YOUR TEST EQUIPMENT AND THE SYSTEM USED TO METER AND DISPENSE THE PRODUCT WORK, HOW THEY MAY MALFUNCTION, AND HOW THEY SHOULD BE OPERATED IN CASE OF AN EMERGENCY.

KNOW WHAT TO EXPECT UNDER THE VARIETY OF CONDITIONS THAT MAY OCCUR IN THE FIELD SO THAT YOU CAN ANTICIPATE DANGEROUS SITUATIONS BEFORE THEY DEVELOP AND TAKE STEPS TO AVOID THEM.

KNOW HOW TO DEAL WITH AN EMERGENCY IF IT SHOULD OCCUR, AND HOW TO PROTECT YOURSELF, THOSE AROUND YOU, AND THE GENERAL PUBLIC.

Some of this knowledge you will acquire from study and in the classroom, some from observing experienced inspectors perform field procedures using correct safety practices, some from demonstrations of emergency measures, and much from practicing under the supervision of your instructor or another certified inspector.

This chapter will present an introduction to each of these important areas of skill and knowledge. We will also look briefly at standard safety equipment. This chapter is intended, however, only as an orientation to the topic of safety. Your instructor will describe other safety training required by your jurisdiction.

SAFETY EQUIPMENT

The following items of safety equipment must be available whenever you examine a loading-rack metering system. The facility at which you are testing should maintain similar equipment, but you should not depend upon its being available. Since you must carry most of these items with you when you go into the field, it is good practice to prepare a checklist, which can be consulted in advance.

- Fire extinguishers. Different types of fire extinguishers are used for fighting different types of fires. One or more portable dry chemical extinguishers, suitable for at least Class B fires (flammable liquids and vapors) and Class C fires (electrical) is recommended. The extinguisher(s) should have a total capacity of at least 20 lbs dry chemical and should be available at all times. The extinguisher(s) should be tested and renewed periodically following manufacturer's instructions to assure that they are in good working order. You must not depend upon the operator's fire extinguishers, even though fire codes require them to be available.

- First aid kit. The first aid kit you carry with you should contain supplies necessary for treating burns, cuts, and shock while emergency medical aid is on its way. You should carry such supplies as bandages, gauze, and adhesive tape.

- A hardhat should be worn, because some moving components of the metering system (for example, loading arms) and some connections to the prover are near or above head level.

- Gloves should be worn whenever you are working with the metering or test equipment, and should not be considered to be for emergency use only. Surfaces often contain a film of product and/or lubricant. Prolonged exposure is not good for the skin. In addition, gloves insure a good grip, which is especially important when working with heavy equipment.

- Protective goggles or eyeglasses should be worn whenever working around mechanical equipment.

- Caution signs must be positioned before you begin examination procedures to prevent vehicles or pedestrians from moving through the area you are working in. The signs may be painted to read, for example, "Hazardous Area -- Flammable Materials -- No Visitors -- No Smoking".

- Phone numbers of the local fire department, emergency medical facility, and other appropriate public safety agencies must be available. You should carry a card or notebook with these emergency numbers at all times.

Several features of the design of your test equipment should be mentioned in regard to safety. Test equipment will be described more fully in Chapters 5 and 7.

- All provers should be equipped with overfill sensors. These devices sense when the liquid level is approaching the top of the prover, and transmit a signal which actuates the metering system's emergency shutoff. This is especially important when testing loading-rack meters because the high discharge rates that are characteristic of these systems allow little time for the operator to react to potential emergencies. If a spill does occur (for example, because the quantity preset fails or was improperly set), these sensors will minimize the amount.

- Provers should also have explosion-proof motors, switches, and junction boxes, and other electrical apparatus when used with flammable substances.

- All provers must also be equipped with means for effective electrical grounding. Again, this is especially important with loading-rack metering systems because the high volume and discharge rates will generate static electricity.

  If not continuously drawn to ground, the prover can act as a large capacitor, storing the charge until it is large enough to create a spark and thereby ground itself. Because flammable and explosive vapors are often present in and around the prover, any such source of ignition must be avoided.

- To further minimize the risk of fire from static discharge, buckets used to catch product should be made of metal and should be capable of being grounded (for example, by attaching a grounding wire).

This list of safety equipment should be considered as a minimum. Your instructor will describe to you other items that are required or recommended by your jurisdiction.

ROUTINE SAFETY PRACTICES

Most dangerous situations can be avoided by strictly observing routine safety practices in the field at all times. These include proper use and maintenance of test equipment, as described in Chapter 5, and a thorough understanding of the operation of the metering equipment, a topic to which you have been introduced in earlier chapters. Whenever possible, you must be able to anticipate critical situations before they actually occur and be prepared to deal with them if they do.

The following guidelines should be observed at all times. This list is intended to acquaint you with general safety practices and does not include every specific situation that may occur.

- DO NOT SMOKE or permit smoking within 100 feet of your test area. If employees refuse to comply with your request that they observe this basic safety practice, halt the test immediately and ask to speak to a supervisor. Any means of producing flame or sparks should also be prohibited in this 100-foot safety area.

- As you inspect the device, be on the lookout for leaks. Report any found immediately to the operator and do not proceed with your examination until the cause of the leak is discovered and repaired. If the leak can not be stopped, terminate the examination and notify the owner of the equipment.

- Report to the operator immediately any exposed electrical wiring on or near the metering equipment. As with leaks, do not continue your examination procedures until the problem has been corrected.

- Never leave equipment unattended while in operation or when set up for operation. You should not leave the work area until your examination is complete and your equipment has been disconnected from the metering system and secured.

- Chock the wheels of the prover to prevent it from rolling.

- Eliminate all possible sources of electrical discharge (sparks) within the work area, including static electricity. Do not wear clothing made of synthetic fibers or any other material that tends to produce static electricity. Synthetic materials should also be avoided because they will melt in the presence of high heat and will stick to the skin, causing serious burns.

- Always ground your prover with a grounding cable (see Chapter 5), and make sure that the electrical supply line for the prover pump is in good condition and protected from damage while in use. Do not cut off the grounding prong on your prover power cord.

- Make sure that all connections you make to the metering system are tight and that valves and other control devices are in their proper position before commencing to dispense product (see Chapter 5). Check them periodically.

- When disconnecting couplings or other product connections, place a bucket or pan underneath to catch the small amount of liquid that will spill.

- Keep the prover's dome cover closed unless it is necessary to open it (for example, for inspection, or for an open tank delivery).

- When inspecting the inside of the prover (see Chapter 6) do not place your face directly over the opening of the prover neck. Use a mirror with an extendable handle and an explosion-proof flashlight.

- If vapor concentration in the area is high (because of a spill or some other reason), complete the specific test you are performing and move away from the area until the vapor dissipates.

- If any practice on the part of the operator, or any procedure required by your jurisdiction arouses concerns about safety, discuss it with the appropriate supervisor immediately and before resuming operations in the field.

Two additional items require some special discussion. The first of these is the practice of switch loading. Switch loading involves the use of a prover that has recently been used with one product to measure a different product. Aside from the (relatively insignificant) contamination of product that will be returned to the owner's storage, the major cause for concern relates to static electricity and explosive vapor.

Static is generated by friction within the flowing liquid and between the liquid and other materials with which it comes in contact (metal or plastic piping and fittings, the discharge hose, air, etc. In general, the more viscous (thick, syrupy, sticky) a liquid, the more its tendency to generate static electricity, when compared with a substance of similar chemical composition. (Viscosity is the property of fluids to resist internal flow.)

For example, diesel fuel is relatively viscous, and is likely to generate static as it flows into the prover during a test draft. On the other hand, it is considerably less volatile than many petroleum products, like gasoline, and thus does not normally generate explosive concentrations of vapor during loading.

However, a prover that has recently been used to measure gasoline is likely to contain significant concentrations of vapor. If loaded with diesel, a potentially dangerous combination can occur: explosive vapor and a rapid enough buildup of static charge to produce a spark.

As a rule, it is not prudent to load a prover that has recently held gasoline with diesel, although gasoline may safely be loaded in a prover that has recently been filled with diesel (since diesel is not flowing, there will be no static generated). There is no general rule that can be applied to all situations in which switch loading is necessary or desirable for the sake of efficiency. Your instructor will explain your jurisdiction's policies regarding switch loading to you.

The second item relates to caution while loading the prover. Because the operation of the metering system is, for all intents and purposes, automatic, and because you have other things to do (check for leaks, read thermometers and record temperatures, time the discharge rate, etc., as described in Chapter 7), it is easy to ignore the fact that product is being delivered at a rate of 500 gpm or more.

Although it does not happen often, the quantity preset can fail to halt the delivery. Overfill sensors should provide protection in this event, but they also have been known to fail, usually because of a bad connection. In any event, the overfill sensor can, at best, be relied upon to minimize a spill, not prevent it altogether.

You need to be aware, from the beginning of the delivery to its conclusion, how much product is in the prover (according to the system register, whose accuracy may also be in question), and how much remains to fill it. Remember that the space above the capacity line on the prover neck may not accommodate more than a few gallons of product.

One way to assure that the delivery is being monitored is to assign this task to your assistant, and have him or her call out the indicated gallons periodically, but at smaller intervals as the delivery nears its conclusion. For example, the assistant might call every 100 gallons up to the last 300; every 50 gallons from 300 to 100; every 10 gallons to zero.

You should also listen for the changes in flow rate that signal that the system is preparing itself for the end of the delivery. It is a good idea to note the indicated gallons when this occurs during the wet-down draft (see Chapter 5), when you will not be as busy as otherwise and test results do not matter. Then listen for the stepdown during each subsequent delivery. If it does not happen approximately when expected, be alert. You should still have plenty of time before the prover is full, but you may have to halt the delivery manually.

The assistant should be positioned throughout the delivery so that he or she is within reach of the emergency shutoff switch (usually on the quantity preset), and should be able to react instantly at a signal from you.

The safety practices described in this section are general in nature, and are not intended to replace any specific safety guidelines or procedures established by your jurisdiction. Your instructor will provide you with copies of any written procedures and review them with you in detail. Do not hesitate to discuss with your instructor any questions or concerns you have regarding safety.

EMERGENCY PROCEDURES

Proper installation, operation, and maintenance of metering equipment and your own test equipment, together with strict observance of routine safety procedures in the field, will minimize the chance of a situation arising that calls for emergency measures. As long as the hazardous substances you are dealing with remain contained within the metering system and your test prover and pressures and temperatures are maintained within normal ranges, the products themselves pose virtually no threat to you.

However, as mentioned at the beginning of this chapter, the reason for stressing safety when working with these metering systems is not the inherent risk that an accident will occur, but the fact that a large quantity of product may be involved in the remote event that one does occur.

If a critical situation develops, it is likely to develop very quickly -- far too quickly for you to consult procedures that you are unfamiliar with and have never had to use before. Accordingly, you must review and practice emergency procedures periodically, and be conscious at all times of the need to be prepared for what you have not yet seen or anticipated.

In general, the owner or operator of the metering system is responsible for the equipment and the safety of those who work with it. If an examination is being conducted on the owner's property, trained personnel and equipment should be available to deal with any emergency. In that event, your role should be to stand by to assist as requested, and to take whatever steps are necessary to safeguard yourself and your test equipment. However, emergency situations develop quickly, and you should be prepared to take appropriate actions as necessary while waiting for assistance.

Once again, the following represent the major emergency procedures you should master. You will practice these and other appropriate procedures during the course of your field training.

As the fire triangle in Figure 4-1 shows, three elements must be present to start or sustain a fire of any kind. These three elements are fuel, oxygen (air), and a source of ignition, such as flame or sparks. If any one of these three elements is absent, there will be no fire.

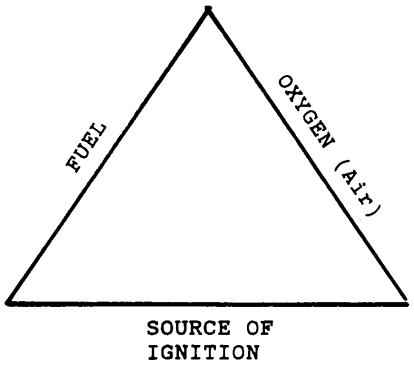

Figure 4-1. The fire triangle.

In the event of a leak or spill of product from either the metering system or the proving system, two of the three necessary elements in the fire triangle (air and fuel) will already be present.

If there is a significant or continuous leak, but no source of ignition, the primary concerns are to stop the emission of fuel and to prevent ignition. Actions should be taken to:

- Halt the emission of fuel immediately (as noted earlier, your role should be to assist the trained personnel provided by the equipment owner if requested, unless for some reason they are unable to take the necessary actions). Summon others on the scene or emergency services if necessary.

- Turn off all pumps and motors that are operating, including those on the prover.

- Survey the safety area for any possible source of ignition. If any source of potential ignition is present and can be removed or eliminated, do so immediately.

- When emergency personnel arrive, yield control of the situation to them and stand by. Keep all employees or onlookers who are not needed to deal with the situation at least 200 feet away from the area of the leak.

- If the leak can not be stopped by closing valves, continue to monitor the situation carefully, warning people away from the area, watching for possible sources of ignition.

If there is fire, the situation may become more critical, depending upon the type of fire and its proximity to storage tanks, pipelines, or other sources of fuel. In addition to the measures described above for policing the safety area and summoning assistance, decisions must be made about the appropriate strategy for stabilizing the situation and preventing it from deteriorating further. It may be necessary for the inspector to make some of these decisions very quickly, and perhaps before help has arrived.

- It must first be determined whether the fire poses an immediate threat to the storage tanks (or the prover, if it is full). If the fire is sufficiently far away, the first priority should be its extinction.

- If the origin of the fire is electrical and the power source can be shut off, this should be done. If the fire is relatively small, a dry chemical extinguisher should be sufficient to put it out.

- If solid material, such as wood, is on fire, water is the best means of extinguishing it. However, water should never be sprayed on a burning petroleum substance or any other burning liquid. Nor should water be sprayed directly on an electrical fire unless the electrical source has been switched off.

- If it is possible to move a source of flame away from the prover, this should be done. If it is possible to move the prover to a safe distance from the flame, this is obviously desirable.

Any metering system or prover involved in a situation requiring emergency procedures like those described above should be taken out of service immediately and inspected and tested thoroughly before being returned to service. This is, of course, absolutely essential for any equipment that has been involved in a fire.

SUMMARY

The potential for very serious consequences as a result of any accident involving a loading-rack metering system necessitates thorough knowledge of safety procedures and continuing training and review of safety topics.

Strict observance of routine safety procedures minimizes the risk of accidents occurring. The owner or operator has primary responsibility for dealing with emergency situations, but the inspector must be prepared to deal with circumstances in which he or she will have to take actions before assistance has arrived.

Three elements are required for any combustion to occur: fuel, oxygen (air), and a source of heat sufficient for ignition. If a leak or spill occurs in the absence of a source of ignition, highest priority must be devoted to halting the emission and avoiding ignition. Any equipment involved in a serious accident must be thoroughly tested before being returned to service.